

ORIGINAL ARTICLES

MICRO-SURGERY IN CHRONIC SIMPLE GLAUCOMA*

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DISCUSSION by Robert Steele Irvine, M.D., San Francisco; Joseph Crawford, M.D., San Francisco; John C. Williams, M.D., San Francisco.

THE writer has recently reported an operative procedure^{1,2} for the relief of chronic simple glaucoma, which consists of opening Schlemm's canal under direct magnified vision. This procedure removes the block to the circulation of intra-ocular fluid which can be shown to be the mechanical cause of the increased intra-ocular pressure. It restores the physiological direction of outflow to the intra-ocular fluid instead of creating an abnormal outlet with its frequent complications and sequelae that may follow present-day operations. By means of a contact glass which has been devised for this special surgical purpose, the operator can see the area of blockage, and can watch and guide his instrument during the operation. The operative procedure when thus performed is without danger, and its objective, namely, opening of Schlemm's canal, can be deliberately performed with the trabeculum under full view. In those cases in which the trabeculum was incised over a sufficient extent, the intra-ocular pressure has returned to normal. According to observations during the last one and a half years, the results show promise of being permanent.

In this article an improvement of technique is suggested which will more certainly insure the opening of the canal. The original technique of operating under 4 x magnification affords a convenient range of some 20 centimeters and a fairly wide field. Because of the moderate degree of magnification, however, one cannot be quite certain of always striking the canal and of opening it over a sufficient extent in all cases. In those cases in which the canal was insufficiently opened, the intra-ocular pressure has been only partially reduced, and a later operation has been necessary to secure normal pressure. The technical variation suggested in this article consists of increasing the magnification from 4 x to 20 x. This increase of magnification is obtained by using the binocular corneal microscope attached to the surgeon's head by means of a helmet (Fig. 1). Although not easy of performance, the assurance of opening Schlemm's canal afforded by this higher degree of magnification would seem to be an improvement over the original technique in those cases where it is indicated.

MICRO-SURGICAL TECHNIQUE OF OPENING SCHLEMM'S CANAL UNDER DIRECT VISION

The surgeon wears a helmet to which is attached a binocular corneal microscope. He helps to steady



Fig. 1.—Photograph showing use of the binocular corneal microscope in author's operation of opening Schlemm's canal under direct vision.

the microscope with his left hand which, in turn, by means of a finger, keeps in contact with the patient's head. A trained assistant standing behind the patient's head for the left eye, and at his right side below the head for the right eye, fixates the bulb at the temporal limbus with a small Elschnig forceps held in his right hand. With his left hand he steadies the surgical contact glass by means of a double-pronged probe which fits into two depressions on the convex surface of the glass. A second assistant guides the narrow beam of the hand lamp from across the bridge of the patient's nose to transilluminate the nasal portion of the limbus and the corresponding region of the angle of the anterior chamber. The surgeon supports and focuses the microscope with his left hand, while he guides the knife with his right hand. He sits on a stool adjusted to such a height that, by means of a slight movement of his head, his gaze may be directed first at the limbus and then transferred above the temporal edge of the contact glass to the anterior chamber, from which point he continues to guide the knife across the chamber by direct vision through the glass. When the blade reaches the highly magnified angle, its point is inserted exactly into that portion of the trabeculum which covers Schlemm's canal and the incision is continued for several millimeters along this line. That this may be accomplished with a high degree of certainty and exactitude is proved by postoperative bio-microscopic examination of the angle, which shows a single straight dehiscence slit of the trabeculum opening Schlemm's canal. What appears to be the glistening white inner lining of the opposite side of Schlemm's canal is clearly visible through this longitudinal bisection of its wall (the sclerocorneal trabeculum may be found to be bisected or sometimes torn off, constituting what may be called either a trabeculotomy or trabeculectomy, as the case may be). The working range is 6 centimeters

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from the patient's eye to the tip of the objective, or 20 centimeters from the patient's eye to the eye of the surgeon. The image is kept in focus by the surgeon shifting his head, and for finer adjustment by using the sliding scale of the microscope, for which the fingers of the left steadying hand are used.

MICRO-GONIOSCOPE

The binocular corneal microscope has in the past been used by some ophthalmologists for the removal of foreign bodies from the cornea. This procedure I have found satisfactory in routine practice for many years, the patient sitting upright with his head on the chin rest. Recently, Schoenberg³ has suggested its use for intra-ocular surgery, and reports attaching the head of the corneal microscope to a stand on a table, at the side of which the patient is lying, in order that it may be used in the course of surgical operations. He suggests that various uses are possible, but does not, as far as I can gather from reading his article, report having actually applied it to intra-ocular surgery nor proved its practicability for this purpose. Before reading his article such a use had occurred to me for my "micro-gonioscope,"² which consists of a binocular microscope mounted on a highly flexible stand; however, the semi-rigidity of even this very flexible apparatus renders it unsatisfactory for purposes of intra-ocular surgery. It was for this reason that I divorced the microscope head from its stand and attached it to the surgeon's head where, with the additional steadying influence of the surgeon's hand, which maintains contact with the patient's head, it works out satisfactorily. Contact with the patient's head is found to be necessary if one considers that the slightest movement between microscope and object is magnified 20 x, and if one further takes into account the narrow breadth of focus and the limited field of vision when using this high degree of magnification. The field of vision, when using the 2 x objective and 10 x ocular combination is only 6.9 millimeters in diameter.

CONCLUSION

Examination of the living eye with the binocular corneal microscope is customarily called "bi-microscopy"; examination of wet specimens of the eye with the same instrument has been termed "micro-anatomy."⁴ To operate within the living eye with this technique may be aptly termed intra-ocular "micro-surgery." As far as I am able to judge from a review of the literature, this is the first time that such high magnification has been applied in intra-ocular surgery.

The use of the binocular microscope, although it demands deliberate care and trained assistance, is feasible, and the procedure of choice when operating on Schlemm's canal under direct magnified vision in those occasional cases where extra assurance of striking the canal is required.

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DISCUSSION

ROBERT STEELE IRVINE, M.D. (490 Post Street, San Francisco).—That the results of the present treatment of chronic glaucoma are far from satisfactory can scarcely be disputed by anyone who will take the trouble to review his own records, or those of any clinic, where a fairly large amount of material is available. We frequently see these patients with a gradual loss of vision, despite our efforts; until the familiar and tragic white cane appears on the scene.

This paper of Doctor Barkan's is the summation of what he has written and done within the past three or four years, and presupposes some knowledge of the foregoing. It is an application, in a greatly improved manner, of the surgery of De Vincentiis, controlled by visualization through a contact glass such as heretofore had been limited to diagnostic purposes only in the attempts by Trantas, Koeppe, Frick, and Troncoso. He has set up definite conditions for its application, which enable him and us to determine its possibilities.

I have had the privilege of examining with Dr. Otto Barkan several of these patients, both before and after this microsurgery, and with his equipment the demonstration is not difficult and is indeed striking. I have also seen the operation performed, have seen the records of patients, over a period of two years, and have been impressed by the freedom from operative trauma, and the consistency of the results, as to the reduction of tension. The pigmented trabecular line can readily be recognized and incised under direct, magnified vision. There is no loss of aqueous, with the resultant plasmoid fluid, to further unbalance the mechanism.

Most of us are accustomed to working under high magnification, such as removing foreign bodies with a corneal microscope or slit-lamp, but unless this dexterity is present it does require unusual coöperation by the assistants and some skill, to avoid damage to the iris or scleral spur, or perforate the cornea. This is the reason for visual control throughout the incision. The difference between the arc produced by the knife, and that of the limbus must be considered.

This paper stresses the latest development in higher magnification, which, up to the point of too much narrowing of field or distortion, insures greater accuracy in placing and controlling the incision; a new field of surgery for which we should be appreciative.

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JOSEPH CRAWFORD, M.D. (Medico-Dental Building, San Francisco).—Before discussing this modification of the author's operation for the relief of chronic simple glaucoma, by using a binocular corneal microscope attached to the surgeon's head, instead of an ordinary loupe, a brief description of the operation itself may be in order. If we accept the author's premise that the most frequent cause of chronic simple glaucoma is obstruction of the flow of aqueous from the anterior chamber into Schlemm's canal with a consequent rise of the intra-ocular pressure, any operation reestablishing this function of that canal is indicated. Most of the operations used today for the relief of chronic simple glaucoma are external, filtering operations, in that they provide egress for the aqueous that is drained off imperfectly. De Vincentiis, in 1892, first suggested an internal incision in the iridic angle to reestablish the normal route through Schlemm's canal; but due perhaps to the danger of the operation—for it was a blind one—it was not accepted generally. The danger is that of injury to the ciliary body, with resultant hemorrhage. Similarly other operations which are now also almost obsolete, such as anterior sclerotomy and internal sclerotomy of de Wecker, when they were effective in this type of case would appear

to have been so by virtue of their having struck the trabeculum on their way into the chamber. Otto Barkan first suggested the idea of incising Schlemm's canal from the inside while it is under direct binocular observation. He devised a contact glass which, when used with a loupe and a good source of focal illumination, makes it possible to incise the sclerocorneal trabeculum over Schlemm's canal while it is under full view. This type of internal filtering operation has much to recommend it, because it restores the physiological direction of outflow for the aqueous.

The magnification with a loupe is four times. Greater magnification is desirable. The binocular microscope increases the magnification to twenty times, but at the expense of working distance, breadth of field, and steadiness of image. Anyone who has tried removing a corneal foreign body under a slit-lamp can appreciate the difficulties of operating with these limitations. To perform such a delicate operation, as incising the sclerocorneal trabeculum with the microscope fastened to the surgeon's head, would make the operation too difficult for any but the most skilled operator.

While I have not as yet performed the operation, due to lack of a suitable contact glass, through the courtesy of Doctor Barkan I have had the opportunity of seeing a number of patients on whom he has operated. The results were so much better than one could expect from operations for the relief of chronic simple glaucoma that one cannot avoid being enthusiastic about its possibilities. Patients who had a persistently high tension with typical glaucoma fields before operation, had normal tensions for as long as a year after operation. The need for continued use of miotics had ceased. Amazingly enough, in one or two cases, there was an increase in the visual field. Most astounding of all was the fact that there was no visible evidence of an operation except by examination with the microgonioscope. The usual signs of a filtering operation, such as distorted iris, conjunctival scarring, bleb formation, etc., were lacking. Instead, an examination with the slit-lamp and contact glass revealed in the iris angle a long, gaping slit in the trabeculum, so well described by the author in previous articles. No one could see these postoperative results without the conviction that, at least in many cases of chronic simple glaucoma, surgical relief is possible and the operative problem is solved.

It appears to me that, for routine work, the operation is such an excellent and practical one that every eye surgeon will eventually use it in many, if not most of the cases of chronic simple glaucoma. By using the technique originally described by the author, the operation is feasible for anyone doing ophthalmic surgery.

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JOHN C. WILLIAMS, M.D. (490 Post Street, San Francisco).—The new method of approach of Dr. Otto Barkan to the study and alleviation of glaucoma has already given remarkable results and holds greater promise. As progress is made in the study of the micro-anatomy of the angle, refinements of technique will follow, and it is on this account that we view with such interest the application of high magnification not only to the study of the angle but, as we learn in this paper, also to the actual surgical procedure. On expressing my interest in his research, Doctor Barkan offered me the opportunity to study his methods and follow the results obtained. In two cases, I have followed the clinical course for a long period before the trabeculotomy, as well as afterward. Full control of the increased intra-ocular tension was never obtained under medical care, with the consequences that central and peripheral vision were gradually decreasing. After opening Schlemm's canal about one-fourth of its circuit, tension has been within normal limits without further use of miotics, and both central and the peripheral vision are improving. It is particularly fortunate in one of these cases that pilocarpin is no longer necessary, since the lids had become sensitized to its use. It may be said, in parenthesis, that miotics are used as a temporary measure after incision of the trabeculum to pull the root of the iris away from the angle until healing has taken place. This period of time is brief, for the after-reaction to this surgical procedure is remarkably slight. It would be feasible to repeat the operation if future time should show its necessity; but patients followed over a period of several months continue to maintain their im-

provement. In certain cases in which the glaucomatous process has not been fully controlled, it has been found that Schlemm's canal has not been adequately opened for a sufficient extent. Results of properly selected cases convince me that Dr. Otto Barkan's procedure in opening Schlemm's canal has proved a notable advance over existing methods in controlling chronic glaucoma. If the use of high magnification fulfills its promise of allowing this work to be done more accurately, it will be held a valuable addition to eye surgery.

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DOCTOR BARKAN (Closing).—I wish to thank the discussers for their contribution to the subject, and their words of appreciation. I have not yet seen any of these openings of Schlemm's canal close up. It is my impression that there is no tendency to heal over. However, the number of cases (twenty-five) operated on to date is too small, and the time elapsed too short to permit of any definite statement in this regard. In those instances where the incision has been insufficient and the result incomplete, it is possible to operate again. Operation is indicated in those cases which I have classified as Type I, and which are characterized by an open angle and a blocked trabeculum. There are also other cases, such as certain types of secondary glaucoma and hydrophthalmus, where the method is applicable. I am glad that the safety of the operation has been brought up, and that, in view of its being so safe, which cannot be said of any other glaucoma operation, one of its main applications may prove to be as an early operation. The operation can be performed by any well-trained and properly equipped ophthalmic surgeon. I expect that the latest model of the surgical contact glass, which was completed a few weeks ago, will prove to be the final one and should be available by you all within the next two months. I should like to take this occasion to suggest that anyone intending to do the operation should familiarize himself with the diagnostic set-up and with biomicroscopy of the angle of the anterior chamber before embarking upon the surgery of it.

PHYSICAL PHENOMENA ASSOCIATED WITH ANXIETY STATES: THE HYPERVENTILATION SYNDROME*

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IN the past several years, increasing emphasis has been placed upon the importance of the interaction of the physical body and the emotions. It is now realized that emotions may precipitate the symptoms of physical disease; and it is assumed that variations in the severity of a disease in a group of patients with the same illness can often be explained by variations in intensity of their emotional disturbances.

The most obvious instances of the interrelationship between emotions and disease have been found in the study of patients who have had secondary psychic manifestations which have necessitated consultation with a psychiatrist. However, there are less well-defined psychological disorders which underlie manifestations of disease; and these are

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